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FARMER PREFERENCES AND MARKET VALUES OF CATTLE BREEDS OF WEST AND CENTRAL AFRICA

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ABSTRACT: World agriculture is based on a small number of animal species and a decreasing number of breeds within each species. Several breeds of West African shorthorn cattle (*Bos taurus brachyceros*) are now at high risk of extinction due to interbreeding. The West African shorthorn breeds are particularly important resources because of their superior abilities to resist diseases, particularly trypanosomosis, and be productive under high humidity, heat stress, water restriction and with poor quality feed. A study was undertaken in the derived savanna area of southwest Nigeria to determine the prospects for conservation through use and possible improvement of the Muturu, a West African shorthorn breed known to be in decline throughout southern Nigeria. An analysis of farmers' breeding practices and breed preferences confirmed a strong trend away from Muturu and identified the traits farmers find least desirable about the Muturu relative to other breeds. An analysis of cattle market prices found small, but significant, price differences by breed. The best hopes for increased utilization likely in other areas of West Africa, such as southeast Nigeria, where the Muturu is better suited to the farming systems and there is a large market for this breed. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. Email address: getinfo@haworth presssinc.com]

KEYWORDS: Cattle breeds, market prices, genetic resources, conservation, Nigeria, West Africa.

INTRODUCTION

The world's animal agriculture is dependent upon less than 20 species of mammals and birds. Within this small number of species, however there is a great pool of genetic diversity. As domesticated animal agriculture spread across the planet during the last 10,000 to 12,000 years, sheep, goats, cattle, pigs, horses and donkeys were exposed to a wide range of environmental conditions. Many of the specialized and

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adapted strains that consequently developed within each species have become extinct or are now in danger of extinction. Hall and Ruane (1993) suggest that 618 breeds of domestic animals have already become extinct. In Europe one third of the surviving 737 distinct breeds of livestock are in danger of extinction (Cunningham, 1992).

Increased concern about the potential long-term costs of genetic diversity loss has focused global attention on the need to conserve plant genetic resources. Animal genetic resources have, until now, received much less attention. Particular interest in the genetic basis of animal agriculture has resulted in an Action Programme for Sustainable Development of Animal Genetic Resources led by the Food and Agriculture Organization. Important components of this Action Programme Are: (i) a global inventory of animal genetic resources and a World Watch List of breeds at risk (e.g., Loftus and Scherf, 1993); (ii) strategies for breed conservation and breed improvement that avoid inappropriate breed replacement or dilution (Cunningham, 1992).

The sub-humid and humid zones of West and Central Africa are home to several cattle populations at high risk of extinction. At very high risk are several breeds/strains of West African shorthorn taurine cattle (*Bos taurus brachyceros*) now found in pockets across the humid and sub-humid zones of West and Central Africa. In the centuries since the predecessors of these breeds were introduced into West and Central Africa, the Bos taurus breeds (both the West Africa shorthorn breeds and the longhorn N'Dama) have developed the ability to survive and be productive in areas of low to moderate trypanosomes risk without the aid of drugs. Such breeds are therefore known as trypanotolerant. The Bos taurus breeds are also reported to have superior levels of resistance to other diseases (streptothricosis, ticks and tick-borne disease, helminthiasis) as well as abilities to be productive under high humidity, heat stress, water restriction and poor quality feed (Murray et al., 1990; d'Ieteren, 1994; Rege et al., 1994). These superior adaptive abilities make these breeds valuable for further livestock development in West and Central Africa and other harsh environment around the world. Loftus and Scherf (1993) report that five West Africa shorthorn breeds have already become extinct. Rege et al., (1994) indicate that the following breeds, with estimates of current population shown in brackets, are currently in the greatest danger of extinction: Bakweri (800-1,300 head), Bakosi (1,000-1,300), Kapsisi (3,000-5,000), Doayo (5,000-7,500) and Liberian Dwarf (5,000-12,000).

The main threat of extinction for these breeds is interbreeding, especially with the humped *Bos indicus* breeds that have moved into the sub-humid and humid regions of West and Central Africa during the last 30 years. This movement has been encouraged by two forces. First, high population pressure and periodic droughts in the arid and semi-arid areas have prompted pastoralists with zebu cattle to extend their seasonal transhumance and relocate their permanent settlements further south in the sub-humid zone where feeds and water are more plentiful (Speirs and Olsen, 1992). Second, in recent years the risk of trypanosomosis caused by tsetse flies (*Glossina spp*.) has declined in the sub-humid zone due to tsetse control measures and land clearance for expanded crop production (Putt et al., 1980; Bourn, 1983). Crop-livestock interaction and mixed farming have consequently been evolving in response to two simultaneous processes. The dominant process is that of transhumant pastoralists becoming sedentary pastoralists and eventually agro pastoralists producing both crop and livestock. Early settlers reared a

mix of trypanotolerant and Zebu breeds in order to minimize risk, as trypanosomosis did not disappear altogether. More recently, a reversal of trend toward Zebu is observed.

The other process is that the existing crop-livestock farmers who own trypanotolerant cattle are acquiring small numbers of trypanosusceptible zebu cattle, and some crop farmers, retired civil servants and urban businessmen hitherto not experienced in cattle raising, are purchasing cattle. These latter groups of investors tend to give their animals to settled Fulani cattle farmers for management on a caretaking basis or hire Fulani herdsmen until they gain enough experience to take up management themselves (Jabbar, 1993; Jabbar et al., 1995). It is projected that mixed farming will evolve and dominate the farming systems in the sub-humid zone of West Africa in the near future (Winrock, 1992; Okoruwa et al., 1996). Which breeds of animals will accompany this evolution remains an important question.

Ultimately both the rate of interbreeding among different breeds of cattle and the success of any conservation or improvement strategy depends upon the actions of the farmers who own and utilize those animals. *Ex ante* assessment of farmers' breeding strategies and breed preferences can assist breed conservation and improvement efforts in several ways. First, it can help to assess current stocks of different breeds held by farmers, the geographic distribution of those stocks, and the likely future trends in those stocks. Interbreeding is more likely among animals raised in close proximity and is almost ensured when different breeds are raised in the same herd. Second, farmers' knowledge about specific attributes of different breeds under village conditions can help to focus scientific research on particular traits and identify needs for extension and farmer education. Third, information about farmers' breeding practices and breed preferences can help to identify the likely market for existing or improved breeds. Fourth, it can help to determine the incentives that might be required by farmers for the conservation of threatened or endangered breeds.

Information from the market can help to complete the story begun by farmers. Market information that reveals buyer preferences for different breeds and attributes can be useful in the design of breed improvement schemes. Livestock owners who have specialized in the production and sale of animals will be particularly concerned with the way different breeds are regarded by the market. Even multipurpose milk and meat producers will be interested in the likely market value of animals that might be culled or sold to meet cash needs.

This paper describes a study of livestock owners' breeding practices and breed preferences undertaken in south-western Nigeria in 1993 and 1994. The primary objective was to improve understanding of farmers' breeding practices and breed preferences in order to help target private and public programs of breed conservation and improvement. A secondary objective was to evaluate participatory and quantitative techniques for assessing livestock owners' breed preferences and the signals sent to farmers by livestock markets.

RESEARCH DESIGN

The Study Area

Figure 1 illustrates the geographical distribution of cattle breeds in West and Central Africa as of the mid-1970s. The 7 million Bos taurus cattle, including the 4.8

million N'Dama and the 2.2 million West African Shorthorns, were most numerous in the more humid southern region, the trypanosusceptible *Bos indicus* breeds were most numerous in the drier northern region, and most of the three million cross-breeds were found in the boundary area between the two regions (OLCA/FAO/UNEP, 1979). The present study focused on a boundary area for 3 reasons: interbreeding and genetic introgression is most likely in those areas; farmers in those areas are more likely to have the option of bringing different breeds into their herds; and farmers in those areas are more likely to have information about the advantages and disadvantages of different breeds. The particular boundary area chosen for this study is in the derived savanna ecozone- a transition zone between humid and sub-humid zones- of Oyo State, southwest Nigeria, where most of the cattle in southern Nigeria are located. Cattle breeds commonly found in southern Nigeria are: Muturu- a trypanotolerant *Bos taurus*; white Fulani- a tryanosusceptible *Bos indicus*; Keteku- a stabilized cross between Muturu and White Fulani; and N'Dama- a trypanotolerant *Bos taurus* introduced into southern Nigeria through breed improvement programs undertaken during the last 20 years.

As of 1959 there were about 65,000 cattle in southern Nigeria, most of which were Muturu and Keteku. Since that time large numbers of White Fulani cattle have been moved into the region by Fulbe pastoralists (Blench, 1994). The cattle population increased to 100,000 in 1974/75, to 140,000 in 1984 (ILCA, 1992) and to 234,000 in 1990 (RIM, 1992). At the same time the numbers of trypanotolerant animals in the region, particularly Muturu and Keteku, have decreased. The number of Muturu in all of Nigeria has decreased from about 200,000 in 1938 to between 60,000-115,000 at the present time (Hoste et al., 1992; Akinwumi and Ikpi, 1985; RIM, 1992).

Between 1980 and 1983, 5,000 N'Dama were imported from the Gambia to Nigeria as breeding stock. These were multiplied and disseminated from five government ranches in southern Nigeria. The total number of N'Dama in the country increased from 14,800 in 1975 to 24,800 in 1984 (ILCA/FAO/UNEP, 1979; Hoste et al., 1992). Although N'Dama is raised as multi-purpose animals in The Gambia, early adopters of the N'Dama in southern Nigeria raised them primarily for beef (Jabbar et. al., 1995).

Collection of Household and Matrix-Rating Data

A survey of cattle-holding households in the derived savanna ecozone of Oyo state was conducted between January and June 1994. Oyo state is divided into four administrative zones for agricultural extension purposes Ibadan, Oyo, Ogbomosho and Shaki. Of these, Ibadan falls primarily in the forest zone, has a small number of Muturu cattle, but very few cattle of any other breed. The study therefore focused on Oyo, Oghomosho and Shaki zones where combinations for breeds were known to be raised. Each zone is divided into a number of blocks each containing 50-80 villages and 5,000-10,000 households. Based on information provided by the Ministry of Agriculture, previous surveys and key informants, two blocks were purposively selected from each of the three zones to represent the different agro climatic situations within the derived savanna ecozone of Oyo state.

In the 6 sample blocks there were 377 villages and 41,321 households of which 292 (less than 1%) were described as settled cattle farmers, i.e., farmers engaged in both livestock and crop production with a semi-permanent or permanent dwelling. All other

households were principally crop farmers with some small ruminants but no cattle. Of the 292 settled cattle farmers, 66 had cattle when they settled but for a variety of reasons had no cattle at the time of the survey. Individual interviews were conducted with the 226 households who held cattle at the time of the survey. Among them 210 belong to the Fulbe ethnic group who migrated from the north and 16 belong to the local Yoruba ethnic group. We focused on livestock farmers because they hold most of the livestock and likely have more familiarity with a variety of breeds. Data were collected on settlement, breed and sex composition of cattle herds, and sources of cattle currently in the herd. Respondents were also asked open-ended questions about the main advantages and disadvantages of 5 breeds with which they might be familiar- White Fulani, Keteku, Muturu, N'Dama and crosses of White Fulani and N'Dama.

Respondents were asked to rate the 5 breeds according to the criteria that had emerged as most important from previous studies (e.g., Mohammed, 1990; Jabbar et al., 1995) and through key informant interviews with cattle farmers. The matrix rating, or repertory grid, method was used to generate a matrix of breed ratings for each respondent. The matrix rating method was originally developed by cognitive psychologists and has been applied to market research, urban geography, and agricultural technologies such as crop and tree varieties (e.g., Ashby et al., 1989; Asfaw Negassa et al., 1991). Variants of the matrix rating method have been used in pastoral systems for investigating people's understanding and perceptions of the importance of different animal diseases and feed sources (Waters-Bayer and Bayer, 1994).

In this case, a board was prepared with 5 breeds on the vertical axis, each breed identified with a photograph, and descriptions of 9 evaluation criteria on the horizontal axis. The criteria were: milk yield, disease resistance, size of animal, ease of handling, market value, marketability (ease of finding buyers), ability to graze diverse species of grasses, need for moving long distances for grazing, and overall desirability. An animal with higher grazing diversity would have less need for moving long distances for grazing. The meaning of each row, column and cell in the matrix was explained to each respondent during the household interview. Each breed could be rated between 1 (poorest or lowest) and 10 (best or highest) for each criterion, so the respondent was asked to consider the first criteria and put between one and 10 bean seeds in the cell corresponding to each breed. The respondent was then asked to consider the remaining 8 criteria in the same way.

Of the 226 interviews that were conducted with sedentary cattle farmers, 204 (90%) produced complete data regarding breeding practices and breed preferences. The 22 who produced incomplete data were all cattle owners who did not rear the cattle them selves but instead gave their animals to one or more Fulbe cattle keepers for caretaking. Those caretakers were included in the sample. Some of the 22 owners gave information on the number of animals they owned and nothing else, some provided partial information about their animals; others could not be reached during the survey because they were not full-time farmers or full-time residents in the villages where their animals were kept. None of the Yoruba cattle owners provided complete data.

Logit Analysis of Relation between Breed Preferences and Breeding Practices

The data on breed preferences and breeding practices from the household survey were combined in an analysis of factors affecting the breeds of cattle that farmers actually

kept at the time of the survey. The primary interest was to investigate factors affecting the holding of trypanotolerant cattle, including Keteku, N'Dama, and N'Dama x White Fulani crosses. Logit models were fitted to the data and the following hypotheses tested:

i. Households involved in caretaking arrangements were more likely to keep trypanotolerant breeds. This hypothesis is supported by the results of an earlier survey of 56 per-urban agro pastoralists in Oyo State (Mohammed, 1990).
ii. Households settled longer in their present location were more likely to keep trypanotolerant breeds; this hypothesis is supported by the results of an earlier survey of 66 sedentary Fulani cattle keepers in five southwest Nigeria states (Jabbar et al., 1995).
iii. Households reporting cattle keeping as their main occupation were less likely to keep trypanotolerant breed(s).
iv. Households that gave high ratings to the trypanotolerant breeds were more likely to keep those breeds. Adesina and Zinnah (1993) found that the perceptions of West African farmers of available technologies affect their adoption of those technologies.

Collection of Market Data

A rapid appraisal of cattle markets in southwest Nigeria was undertaken to characterized pattern of trade and breeds of animals exchanged at each market. The Shaki market was chosen for in-depth study since the greatest variety of cattle were exchanged there. The Shaki market is located in the northwest of Oyo state, about 10 kilometers from the border between Nigeria and the Republic of Benin. Data were collected for 2,688 cattle transactions conducted on 49 market days between November 1993 and June 1994. Data were collected more frequently when more animals were exchanged such as before festivals. Key informant interviews prior to the survey indicated that the principal supply/demand peaks in the market coincide with two major festivals: the Christian festival of Christmas and New Year and the Muslim festival of Eid-el-Kabir. Both of these occasions were covered by the survey period so that the most important seasonal fluctuations were covered by the survey period.

All data were collected on Mondays, Wednesdays and Friday. Five breeds of cattle were exchanged during those 49 market days: Muturu, Keteku, N'Dama, White Fulani and Sokoto Gudali (another zebu breed). The rapid appraisal indicated that relatively few trypanotolerant cattle were exchanged compared to the trypanosusceptible breeds. In order to ensure adequate sample of all breeds, data were collected for all transactions involving N'Dama, Keteku and Muturu and a random sample of transactions involving White Fulani and Sokoto Gudali. For each transaction, data were collected o price (Nigerian Naira per head) and various factors hypothesized to affected price: attributes of the animal (breed, type, sex, colours, size, condition score), attributes of the seller (occupation ethnicity, sex, location/destination, distance to travel, mode of transport, reason for sale, distance traveled, mode of transport) and attributes of the buyer (occupation, ethnicity, sex, location/destination, distance to travel, mode or transport reason for buying).

Animals are not weighed at the Shaki market, but the ability of buyers and sellers to make accurate estimates of sizes, weights and dressings percentages of animals helps in making good bargains. Height, length and the thickness of the girth are normally used

by buyer and sellers as visual indicators of size and weight. Traders, butchers and caterers are likely to be more proficient in using these indicators because of their experience through frequent handling of animals. For the purposes of this study, weighing animals in the market place was considered impractical, so data were collected on the visual measures of size that were observable to buyers and sellers. A Bovine Weighing Tape (manufactured by WASCO, Fort Atkinson, Wisconsin, USA) was used to measure height at the withers, length and girth circumference.[1]

Implicit Price Analysis

An implicit or hedonic price function was estimated to relate the price per animal to its various attributes and characteristics. The maintained hypothesis of implicit price analysis is that products have attributes that confer utility and that the values of those attributes contribute to the price of the product, the observed product price is therefore a composite of the implicit prices of the products attributes (Rosen, 1974). In this analysis the focus was on the importance of breed relative to other attributes likely to affect the price of cattle. The hypothesis that was tested was as follows: everything else equal, there were no differences in price per animal due solely to breed.

In a competitive market an implicit price will be a function of the product attributes alone and not of individual consumer or supplier attributes (Oczkowsi, 1994). However, most studies have found that price is also related to attributes of the buyers and sellers, implying some non-competitiveness in the market (e.g., Andargachew and Brokken, 1993; Francis, 1990; Oczkowsi, 1994; Rodriguez et al., 1995).

The general form of the implicit price function is given in equation (1):

$$P=F(Q, C) + e \qquad (1)$$

Where P is the observed price of the product, Q is a set of qualitative (discrete) variables; C is a set of quantitative variables, and e is an error term. Interaction variables may also be incorporated. The partial derivative of the estimated function with respect to a quantitative variable is the implicit marginal value of the attribute. We tested for quadratic relationships between price and the continuous quantitative variable by including both the variables and their squares. Qualitative attributes are represented by binary variables so the estimated parameters measure the impact of the presence or absence of the attribute. The SPSS Analysis of Covariance procedure was used to estimate the model. Bonferroni confidence intervals were used in the hypothesis tests in order to reduce the likelihood of false rejection of null hypotheses (Norusis, 1993).

RESULTS OF HOUSEHOLD SURVEY ANALYSIS

Farmers' Present and Past Breeding Practices

Among the 204 sample herds, 69% contained only White Fulani, 24% contained white Fulani and Keteku, 4% contained mixtures including White Fulani, Keteku and N'Dama, and 3% contained only Keteku. None of the herds contained Muturu. The 55 households that were caretakers of animals had been settled in their current location longer than other households (average of 40 years compared to 27 years) and were less likely to hold pure White Fulani herds (47% compared to 77%). Average herd size did not differ significantly between the groups by herd composition ($P > 0.05$).

Table 1 shows how the breed composition of the farmers' cattle holdings changed over time. Over time there was a large shift away from the indigenous Bos indicus breeds, Muturu and Keteku, to White Fulani. In the past, i.e., any time before the survey, 55% of the 204 households reared Muturu or Keteku, at the time of the survey 31 % reared Keteku are none reared Muturu. While 44% of the households that had only White Fulani in the past had some Keteku at the time of survey, 63% of the households that had only Muturu or Keteku in the past had only White Fulani at the time of the survey. Of the 113 farmers who gave reasons for giving up Muturu or Keteku, 75% mentioned poor market value, 66% mentioned low milk yield, 43% mentioned small size, and 27% mentioned wild temperament or difficulty in management or handling.

Table 1: Distribution of sample households according to past and present (January-June 1994) breeds of cattle in the herds, southwest Nigeria

	Present breeds					
Past breeds	White Fulani	Keteku	WF+Keteku	WF+ Keteku+ N'Dama	All herds (n)	All herds (%)
White Fulani	51	4	34	2	91	45
Keteku	21	-	-	1	22	11
Muturu	1	-	12	5	18	9
WF+Muturu	-	3	-	-	3	1
Keteku+Muturu	61	-	2	1	64	31
Mixtures[a]	6	-	-	-	6	3
All herds (n)	140	7	48	9	204	-
All herds (%)	69	3	24	4	-	100

[a]Mixtures of While Fulani, Keteku, N'Dama While Fulani x N'Dama crosses.
Source: Farm survey.

Of the 43 farmers who gave reasons for adding trypanotolerant breeds to their herds, 51% mentioned disease resistance, 26% mentioned ability to graze a variety of grasses, 21% mentioned less need for traveling long distances for grazing, 14% mentioned better quality of milk, and 12% mentioned shorter calving interval.

Data on sources of cattle in the respondents' herds at the time of the survey are presented in Table 2. Those data suggest that caretaking arrangements and interbreeding are the main ways that farmer exercise discretion over the breeds of animals in their herds. Overall 80% of the cattle held by the respondents were inherited or born to animals that were inherited, 14% originated through caretaking arrangements, and just 5% were purchased. Inheritance was the most important source for all breeds of cattle; caretaking was a much more important source for Keteku than for White Fulani.

Farmers' Breed Preferences

The information about the reasons why farmers adopted or eliminated certain breeds from their herds, presented above, provided some insight into farmers' breed preferences. Additional information was obtained by asking farmers' opinions about the

advantages and disadvantages of different breeds and their ratings of different breeds according to a set of pre-selected criteria. Here we report only the results from the matrix rating. The advantages and disadvantages listed by the respondents confirm both the list of criteria used in the matrix rating and the general results of the matrix rating.

Table 2: Sources of cattle by breeds in the sample herds, southwest Nigeria

Breeds in herd	% animals by source			
	Inherited	Purchased	Share of caretaking	Caretaking
While Fulani	85.1	4.5	0.2	10.2
Keteku	56.0	6.7	-	37.3
WF + Keteku	84.1	5.1	1.3	9.5
WF	91.2	5.6	0.3	2.8
Keteku	74.0	4.4	2.6	19.0
Mixtures[a]	19.1	5.1	6.4	69.4
WF	56.9	18.5	3.1	21.5
Keteku	15.1	-	7.5	77.4
N'Dama[+]	-	-	7.7	92.3
WF x N'Dama				
All herds	80.9	0.8	0.8	13.5

a. Same as in Table1.

Source: Farm survey.

Table 3 presents the results of the matrix rating. The most consistent and clear-cut results were for White Fulani. White Fulani were rated highest for milk yield, size, ease of handling, market value and marketability, and lowest for disease resistance, ability to graze a diversity of grasses, and need for mobility when grazing. All of the average ratings for White Fulani are significantly different from those of other breeds ($p < 0.01$). The ratings for Muturu and N'Dama were very similar to each other and almost the polar opposite to White Fulani; Muturu and N'Dama were rated low for every criteria for which White Fulani was rated high, and vice versa. Keteku and White Fulani X N'Dama crosses were generally rated somewhere between White Fulani and Muturu/N'Dama. With only one exception (need mobility for grazing), the average ratings for Keteku were higher than those for White Fulani X N'Dama crosses. In terms of overall desirability, White Fulani were rated highest, followed by Keteku, White Fulani X N'Dama crosses, Muturu and N'Dama.

Relationships between Breed Preferences and Breeding Practices

Three logistic regression models were fitted to relate breeding practices- represented by breeds(s) of cattle in the farmers' herds- to characteristics of the herd and the farmers' ratings of the breed(s). The results of the model in which the dependent variable was whether a household held any trypanotolerant breed at the time of the survey are shown in Table 4. The results indicate:

i. Households that were caretakers of others' animals were significantly more likely to keep trypanotolerant breeds;
ii. Households that had been resident in their present location for longer periods of time were significantly more likely to keep trypanotolerant breed(s);
iii. The greater the rating a household gave on the need for mobility of N'Dama and Keteku, the less likely they were to keep trypanotolerant breed(s);
iv. The greater the rating for ease of handling of the N'Dama, the more likely they were to keep trypanotolerant breed(s);
v. The grater the rating on the disease resistance of the N'Dama, the more likely they were to keep trypanotolerant breed(s);
vi. The greater the rating on the market value of the Keteku, the more likely they were to keep trypanotolerant breed(s). [2]

All of these results were consistent with prior hypotheses.

Table 3: Matrix rating of cattle breeds by sample cattle holders, southwest Nigeria (n=204).

	White Fulani	Keteku	W. Fulani X N'Dama	Muturu	N'Dama
Milk yield	9.4(1.1)	5.5(1.5)	4.7(1.4)	2.6(1.1)	3.1(1.4)
Disease resistance	2.4(1.2)	5.9(1.6)[a]	5.5(1.4)[a]	8.4(1.2)[a]	8.6(1.3)[b]
Size of animal	9.5(1.0)	5.9(1.6)	4.8(1.3)	2.1(1.2)	3.2(1.3)
Ease of handling	9.4(1.0)	5.9(1.7)	4.0(1.3)	2.3(1.1)	1.7(1.1)
Market value	9.5(1.0)	6.3(1.6)	4.4(1.3)	2.1(1.1)	2.8(1.2)
Marketability	9.2(1.1)	7.1(1.7)	4.4(1.4)	2.7(1.3)[b]	2.7(1.4)[b]
Need mobility	2.4(1.1)	6.0(1.4)[c]	5.6(1.4)[c]	8.8(1.2)[b]	9.1(1.2)[d]
Graze diverse grasses	9.6(1.1)	4.6(1.5)	3.8(1.4)	2.0(1.3)[b]	2.0(1.3)[b]
Overall rating	8.7(1.6)	5.9(2.1)	4.7(1.8)	3.1(1.6)[e]	2.6(1.5)[e]

Note: Numbers in brackets are standard deviations. Not reported are the standard errors but all of the standard errors for the attribute ratings were between 0.07 and 0.12. The standard errors for the overall ratings varied between 0.10 and 0.15.

All of the rating differences between breeds are significantly different at the 0.1% level of confidence except the following:
[a]Keteku and While Fulani X N'Dama are significantly different at the 5% level.
[b]Muturu and N'Dama are not significantly different.
[c]Keteku and white Fulani X N'Dama are significantly different at the 1% level.
[d]Muturu and N'Dama are significantly different at the 5% level.
[e]Muturu and N'Dama are significantly different at the 1% level.

Source: Farm survey.

RESULTS OF MARKET ANALYSIS

Marketing Patterns

Table 5 presents data on the origins of the cattle for the 2, 688 cattle transactions that were monitored at the Shaki market. Forty four percent of the monitored cattle came

from the Republic of Benin and 18% came from Burkina Faso. Benin was a particularly important source of Muturu and Keteku: 85% of the Muturu and 75% of the Keteku originated from Benin. Burkina Faso was a particularly important source of White Fulani and Gudali: 35% of all White Fulani and 31% of all Gudali originated from Burkina Faso.

Table 4: Factors affecting the probability of keeping trypanotolerant Cattle in the Herd, Southwest Nigeria

	Full Model			Stepwise		
	Est.Coaef.	Asyrm. St.Err.	Signif.	Est.Coef.	Asym.St. Err.	Signif.
Constant	-12.40	2.58	0.000	-11.08	2.04	0.000
Caretaker(0/1)	1.67	0.47	0.004	1.63	0.43	0.000
Occupation(0/1)	0.38	0.49	0.443			
Years in present location	0.03	0.01	0.003	0.03	0.01	0.04
Ratings for N'Dama						
Need mobility	-0.25	0.20	0.209	-0.36	0.17	0.037
Ability to graze diverse Grasses	0.06	0.21	0.767			
Marketability	0.11	0.16	0.488			
Market value	0.15	0.19	0.426			
Ease of handling	0.46	0.19	0.015	0.47	0.16	0.004
Size	-0.31	0.19	0.097			
Disease resistance	0.42	0.19	0.026	0.41	0.16	0.010
Milk yield	0.08	0.17	0.640			
Rating for Keteku						
Need mobility						
Ability to graze diverse Grasses	-0.41	0.18	0.026			
Marketability	0.10	0.15	0.490			
Market value	0.30	0.17	0.072	0.50	0.13	0.000
Ease of handling	0.05	0.15	0.759			
Size of animal	0.29	0.18	0.103			
Disease resistance	0.08	0.14	0.591			
Milk yield	0.16	0.16	0.948			

Data on the destination of cattle exchanged at the Shaki market show that all of the cattle were destined for consumption, rearing or resale within southern Nigeria. Sixty-three percent of all cattle stayed within Oyo state. The second most important destination was the city of Enugu in southeast Nigeria. Enugu was a particularly important destination for Keteku and Muturu (32% of all purchases of Keteku and 50% of all purchases of Muturu). Muturu are traditionally reared in southeast Nigeria where they have special value for ceremonies (Akinwumi and Ikpi, 1985). Informal interviews with

traders indicate that due to the scarcity of Muturu, Keteku are sometimes used as a substitute.

Table 5: Origin of cattle traded at Shaki market, southwest Nigeria, November 93-June 94

	Local LGA	Rest of Oyo	Kwara	Benin	Burkina Faso	Total (n)
White Fulina	218	170	158	80	347	973
Gudali	85	58	55	31	104	333
Keteku	137	49	40	721	13	960
Muturu	26	18	10	335	6	395
N'Dama	5	20	-	2	-	27
All (n)	471	315	263	1169	470	2688
All (%)	18	12	10	44	18	100

LGA: Local Government Area, a middle level administrative unit.
Source: Market Survey.

Three types of cattle were traded in the market: cows (mostly dry), heifers and males (bulls and steers). Bulls and steers were not separately shown because for some animals the distinction was difficult to establish from recorded data. Sixty-six percent of all cattle traded were males, 29% were cows and 5% were heifers. Sixty-nine percent of the traded animals were sold by traders and 31% were sold by farmers. The main buyers were traders (51%), butchers and caterers (23%), consumers (14%) and farmers (11%), Chi-square tests showed significant relationship between buyer type and breed of cattle, and between buyer type and type of cattle. Traders purchased 62% of the Muturu and 56% of the Keteku, primarily for resale in the markets in eastern Nigeria, and they purchased 48% of Gudali and 44% of White Fulani, primarily for the urban markets of Ibadan and Lagos. Thirty percent of the N'Dama was purchased by consumers, 26% each by farmers and butchers/caterers and 18% by traders. Traders mostly purchased males (86%), while butchers/caterers mostly purchased cows (59%). These different choices might be because traders targeted markets in urban areas and eastern Nigerian markets while butchers/caterers targeted local markets and nearby consumers. Farmer purchases included 7% cows, 32% heifers and 61% male, all the animals except two were purchased for rearing. Since additional questions were not asked, it could not be established how many of the animals purchased by farmers were actually used for breeding and how many for fattening.

Price Relationships

Table 6 reports the results of the most satisfactory implicit price model that was fitted to the data. Other versions of the model indicated that length of the animal and length squared were not statistically significant, so both variables were excluded from the final model. Also, none of the interaction terms between breed and girth and wither height (or their squares) were significant, so these interaction terms were excluded from the final version. The results from the final model indicate that, everything else equal.

Table 6: Determinations of cattle prices, Shaki market, southwest Nigeria (n=2,688) (prices per head)

	Coefficient	St.error
Covariates		
Condition score (2-8)	-313.8**	124.7
Condition score^2	77.4***	12.0
Wither height (inches)	-301.6***	65.0
Wither height^2	4.0***	0.7
Girth (inches)	129.0***	45.1
Girth^2	0.4	0.4
Factors		
Breed:		
White Fulani		
Gudali	-180.5*	83.4
Keteku	-310.9*	71.4
Muturu	-125.3	96.2
N'Dama	601.1*	258.4
Type of animal:		
Male	0.0	
Cow	-1427.9*	77.8
Heifer		
Type of buyer:		
Farmer	0.0	
Trader	458.3*	96.1
Consumer	-141.4	110.8
Butcher/caterer	77.5	110.8
Month of transaction:		
November	0.0	
December	852.8*	71.6
January-February	134.6	83.6
March-April	352.1*	95.1
May	1298.9*	101.8
June	1292.4*	145.2
R^2	0.70	

Note: For coefficients of covariates, **and*** indicate significant respectively at p<1% and 0.1%. For coefficient of the factor categories, *indicates the coefficient significantly different form 0, i.e., the base category within the factor. Here significant is based on 0.95 Bonferroni confidence interval because when joint confidence intervals are constructed, t values are inadequate to determine whether differences are significant (Norusis, 1993).

i. There were significant relationships between price per animal and condition score, girth circumference and height at the withers. The significance of the squared terms indicates that the relationships are non-linear. The negative signs on condition score and height, and positive signs on condition square and height square, indicate that, everything else equal, price increases at an increasing rate as condition score and height increase.

ii. Price paid for Keteku and Gudali were significantly lower than those paid for White Fulani, while prices paid for N'Dama were significantly higher than for White Fulani. N'Dama prices were also higher than those for other breeds. White Fulani and Muturu prices were not significantly different. Price differences due to breed were less than differences due to type of animal and month of transaction, which implies that although N'Dama fetched a premium price, month of transaction and type of animal made greater contributions to price variation.

iii. Cows fetched significantly lower prices than males, while heifers fetched significantly higher prices than cows.

iv. Traders paid significantly higher prices than farmers, consumers or butchers/caterers.

v. The highest prices were paid in May and June and the lowest prices were paid in November. November prices were significantly lower than all other periods, except January-February. The two peak periods coincided with the Christian festival time of Christmas and New Year and the Muslim festival time of Eid-el-Kabir.

DISCUSION AND CONCLUSIONS

Discussion

Farmers have four options for changing the breeds of animals in their herds:

i. purchasing more desirable animals, especially bulls of more desirable breeds;
ii. deliberately breeding cows and heifers with bulls of more desirable breeds in own herd or neighbouring herds;
iii. bringing animals of more desirable breeds into their herds through sharing or caretaking arrangements;
iv. culling less desirable animals and disposing of them by sale or home slaughter.

The options are arranged in order of the amount of deliberate discretion that the farmer exercises: option (i) is the most deliberate and rapid way to exercises discretion over breed, option (IV) is the least deliberate and slowest way to exercise discretion over breed. The results of his study indicate that cattle owners in the derived savannah of Oyo State rarely exercise the most deliberate options (i) and (ii); only 5% of all animals entered the farmers' herds through purchase and farmers only purchased 11% of animals exchanged at the Shaki market and it was not clear how many of those purchased animals were actually used for breeding. Instead they rely on the options of less deliberate discretion.

Nonetheless about 75% of the respondents reported that the breed composition of their herd was different at the time of the survey than it was in the past. There is a strong trend away from the Bos taurus Muturu and Keteku toward the Bos indicus White Fulani. Keteku was developed in the past by farmers as a deliberate choice to combine the disease resistance of Muturu and the larger size and milk yield of White Fulani. However, the decreasing number of Keteku at present indicate that as Muturu have disappeared from farmers' herds, so too may the Keteku. Although farmers acknowledged some clear advantages of the Muturu and Keteku (disease resistance, ability to graze a variety of

grasses), those advantages appear to be of relatively little importance compared to their many disadvantages relative to the White Fulani. Moreover, where disease challenge, particularly trypanosomosis, is smaller, there is less incentive to choose Muturu and Keteku.

The movement away from Muturu in the derived savanna areas of Oyo State is consistent with the aggregate trend in south-western Nigeria. The national livestock survey conducted in the early 1990s (RIM, 1992) found virtually no Muturu in Ogun State where not long ago many farmers held Muturu (Grandin, 1980). The national livestock survey reported 11,623 Muturu among a total of 234,461 cattle in Oyo State (now Oyo and Osun states), with most Muturu located in the forested areas.

The implicit price analysis produced a very satisfactory model of the prices of cattle exchanged at the Shaki market. The measure of goodness-of fit, $R^2 = 0.73$ is about twice as high as the R^2 for similar models estimated by Rodriguez et al. (1995) for sheep and goat prices in Pakistan and Andargachew and Brokken (1993) for sheep prices in Ethiopia.

The results show that there are some differences in prices that are solely due to breed, but that most variation is due to variables such a wither height and girth circumference that vary from animal to animal within breed. Although, other things being equal, N'Dama fetched higher price in the market compared to other breeds, only a small number of N'Dama were traded in the market. This might partly explain why in the farm survey, farmers rated N'Dama low in terms of value and marketability. This contradiction also partly explains why N'Dama population did not expand in the area as rapidly as would be expected after initial introduction by the government funded project. Variation due to type of animal or month of transaction was greater than that due to breed. The significant effect of type of buyer indicates some degree of non-competitiveness or the importance of excluded explanatory variables. The implicit price results indicate that there are important seasonal fluctuations in cattle prices. More results on seasonality would have been generated had data been available over an entire calendar year.

Implications for Conservation through Utilization

The strong trend among the farmers against the Bos taurus Muturu implies that there is very little scope for conservation of the Muturu in the derived savanna areas of southern Nigeria. If trends from the study area expand into the area of Oyo State that is now forested, the population of 11,000 Muturu that is now reported could be interbred to extinction within 20-30 years. This would mean the loss of important resource for Nigeria and all regions of the world where livestock are raised under the stresses of disease, heat and humidity. The ability to be productive under low to moderate levels of trypanosomosis makes these animals more attractive to farmers. Trypanosomosis remains a constraint in southern Nigeria[3] and there is evidence from across Africa of resistance to the drugs available for prophylactic and curative treatment of trypanosomiasis (Peregrine et al., 1994).

With the trend towards more White Fulani in the derived savanna, perhaps breed improvement schemes should focus on ways of improving the adaptation traits of the White Fulani through within breed selection, cross-breeding with breeds such as the N'Dama, or in time, the introgression of trypanotolerant genes. While size, milk yield

and disease resistance are breed characteristics that have received considerable research attention (e.g., Rege et al., 1994), the needs for mobility for grazing and ease of handling have received scant research attention. Breed improvement should be considered with caution, however. Currently farmers acquiring cattle through renting and sharing manage breeds for which they may not have highest preference. The low level of deliberate discretion that farmers are exercising to improve or change breeds suggests that there is limited scope for breed improvement that would require farmers to purchase improved animals. Breed improvement would require education. Farmers in this sample had negative opinions about the N'Dama even though few of them actually had any personal experience with the N'Dama. The results of the logit analysis suggest that cattle farmers with higher opinions of the N'Dama were more likely to keep trypanotolerant cattle.

Research of the type reported here could be a useful component of any appraisal of current and future stocks of the genetic resources used in agriculture. Perhaps the most useful information gathered in this study was on farmers' current and past breed portfolios and the sources of animals in their herds. Reliable information for a large area could be collected with a brief questionnaire administered to a large number of households. Government concerned about animal genetic resources could design agricultural survey or census questionnaires to collect such information. Development projects concerned with breed improvement and dissemination should use the matrix ranking approach to better understand farmers' perceptions of different breeds.

NOTES

1. Height, length and girth were measured following the procedure described by Buvanendran et al. (1980): wither height is the vertical height from the floor to a point just above the spinous processes of the second and third vertebra, length is the distance from the point of the shoulder corresponding to the outer and lateral tuberosity of the left humerus to the left tuber ischii, and girth circumference is the circumference of the body measured perpendicular to the shoulder blade at the 6th-7th rib.
2. When the dependent variable measured whether or not a farmer kept a specific trypanotolerant breed, fewer factors turned out to be significant. Only four variables were significant in explaining whether a household held Keteku and only one factor was significant in explaining whether a household held N'Dama.
3. In 1987, in a sample of 1,525 zebu cattle in 5 states of southwest Nigeria, a mean rate of trypanosome prevalence of 14.4% was found- 18% in the wet and 1.8% in the dry season (Ikede et al., 1987). A repeat survey in slightly wetter and more forested locations in 3 of the same 5 states showed prevalence rates of between 18.5% - 21% in the wet season and 16% in the dry season (ILRI-Ibadan, unpublished data).

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